Modern Communications. THOMAS H. CROWLEY, GERARD G. HARRIS, STEWART E. MILLER, JOHN R. PIERCE, AND JOHN P. RUNYON. Pp. 340, Columbia University Press, New York, 1962. Price $9.75.

Scientific technology is divided into four overlapping regions for investigation, viz., (i) communication and information theories, (ii) energy conversion and utilization theories, (iii) theories of the structure and utilization of materials, and (iv) theories for the transportation of matter. The book under review, written by members of the staff of Bell Telephone Laboratories (Murray Hill), is a broad semitechnical account of the *first* category, with special emphasis on progress during the last fifteen years. However, it is clear from the authors' style that this fine book is directed at an audience with a college education and at secondary-school science teachers in particular. The only remarks the reviewer could find to mar this useful volume occur in the *preface* where the authors write:

> To us "communication" is the sending of a signal from one point to another, usually in a way which permits a two-way "conversation" to take place. We have little knowledge of the technical problems of those parts of the communications industry where a one-way signal is "broadcast" to a large number of recipients, so we do not speak at all of newspapers or advertising, and only to a limited extent of radio and television broadcasting.

Surely, such qualifications are not only unnecessary, but misleading, for if newspapers or other such media did not

provide for adequate "feedback" then there would be no guarantee that they have been communicating at all. Actually it is quite conceivable that the volume of audience reaction (e.g., letters-to-the-editor) to a certain newspaper article may, in fact, exceed that of the article itself. Communication is a *symmetric* relation.

The fifteen chapters can be divided into six sections, to wit, (i) introductory remarks, (ii) speech communication, (iii) modulation theory, (iv) transmission schemes, (v) switching theory, and (vi) information theory. The first section orients the reader to the standard communication model by C. E. Shannon *The Mathematical Theory of Communication* (University of Illinois Press, Urbana, 1948), i.e., to the notions of an information *source*, *transmitter*, *channel*, *receiver*, and *destination* and to their relation. The second section (two chapters) deals principally with characteristics of the mouth as a message source for telephone communication and with properties of the ear as a message sink. The next section (three chapters) considers various schemes of modulation, i.e., embedding information in a carrier signal that propagates the information to another location. For example, amplitude modulation, frequency modulation, phase modulation, pulse-amplitude modulation, and pulse-code modulation are discussed. The fourth section (three chapters) studies the properties and performance of transmission channels such as open wires, coaxial cables and various waveguides. The fifth section (three chapters) treats the theory of trunking and switching of signals, e.g., simple queueing theory and elementary Boolean algebra. The last section (three chapters) builds up to, but does not prove, Shannon's two fundamental theorems for noiseless and noisy channels, *loc. cit.* In addition, it considers certain elementary error-correcting codes [see, e.g., W. W. Peterson, *Error Correcting Codes* (John Wiley & Sons, Inc., New York, 1961)]. These last three chapters also appear in a book by J. R. Pierce *Symbols, Signals and Noise* (Harper & Brothers, New York, 1961).

The work is very well indexed and it should be quite successful in further popularizing information theory.

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